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The
HUSKER-SHREDDER
ON EASTERN
CORN BELT FARMS



THE HUSKER-SHREDDER is very effective in destroying the borers in corn fodder.

In the greater part of western Ohio and southeastern Michigan the fodder grown on about 25 per cent of the 1927 corn acreage was shredded.

Shredding is most important in districts and on farms where there is a shortage of hay and straw for roughage. It is also a common practice on farms that have too few cows to justify a silo and on dairy farms that require a large quantity of roughage for feed and bedding.

Shredded stover has about the same value as unshredded stover for feeding purposes. It is better than timothy hay or straw for milk cows and better than straw for horses.

For bedding, shredded stover is more valuable than straw, and much better than the long unshredded stover.

Tractors with a belt rating of 16 to 20 horsepower are commonly used in operating 4-roll and 6-roll husker-shredders, and 25 to 30 horsepower tractors are used for 8-roll machines.

In corn that yields 35 bushels per acre the husking capacity varies from about 125 bushels a day for a 2-roll shredder to 500 bushels a day for the 10-roll size.

Farmers who hired machines in 1927 paid from \$2.50 to \$4 an hour, depending on the size of the machine and individual agreements as to the number of men and the fuel furnished.

To operate a husker-shredder economically one should shred about 45 acres per season with the 2-roll size, 70 acres with the 4-roll, 90 acres with a 6-roll, 110 acres with an 8-roll, and 135 acres of corn per season with a 10-roll shredder.

The stover should be tramped as little as possible in storing. The hood of the blower should be adjusted frequently so that the wet butts of the stalks and the shelled corn will not accumulate in one place.

From November 15 to December 15 is the best time to shred, in most districts.

This bulletin is based largely on information obtained cooperatively by the Division of Farm Management and Costs of the Bureau of Agricultural Economics, the Division of Agricultural Engineering of the Bureau of Public Roads, the Animal Husbandry Division of the Bureau of Animal Industry, and the agricultural experiment stations of Ohio, Michigan, Indiana, and Illinois, concerning the experience of farmers who used husker-shredders in harvesting their 1927 corn crop.

THE HUSKER-SHREDDER ON EASTERN CORN BELT FARMS

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ONE OF THE MOST DIFFICULT problems in a corn-borer clean-up program is the disposal of cornstalks that have been either husked out of the shock or fed without husking. It is almost impossible to rake up and burn these stalks effectively if they are partly trampled in the manure, and it is difficult to rake and burn them when they are scattered over the barn lot or pasture. Standing stalks that have been husked from the hill may be carefully plowed under, and the borers in the stalks that are cut for silage are destroyed by that practice, but the stalks that are scattered over feed lots and manure piles furnish a dangerous source of increased infestation.¹

Farmers in a large part of the borer-infested and adjacent areas should be interested in shredding as a method of disposal of stalks. This, together with its many other advantages, should make the use of the husker-shredder more general on farms where corn is now husked from the shock by hand or fed without husking. (Fig. 1.)

HUSKER-SHREDDER DESTROYS THE BORERS

The husker-shredder has been found to be very effective in destroying borers in corn fodder. Shredding or cutting corn fodder into fine pieces as is ordinarily done by husking and shredding machines

¹ CAFFEY, D. J., and WORTHLEY, L. H. — THE EUROPEAN CORN BORER: ITS PRESENT STATUS AND METHODS OF CONTROL. U. S. Dept. Agr. Farmers' Bul. 1548, 48 p., illus. 1927.

kills from 98 to 100 per cent of the borers. Most of the borers that escape death in the machines probably perish during the process of storing the shredded material, feeding it to livestock, and using the residue as bedding, finally to be trampled into manure, as is the case in general farm practice. The effectiveness of the machines is increased in cases in which special care is taken to apply sufficient pressure on the snapping rolls to produce a crushing effect and to prevent long pieces of fodder from being whirled through the head without being finely cut or shredded.

In a large number of tests during 1927 and 1928 by the Bureau of Public Roads in cooperation with the Bureau of Entomology in the vicinity of Toledo, Ohio, direct kills of over 99 per cent were secured when the cutter head was set to cut one-half inch, the snap-



FIG. 1.—Cornstalks that are fed as long fodder are a dangerous source of increased corn-borer infestation. The difficulties of satisfactorily disposing of these stalks would be obviated by shredding

ping rolls were set as tightly as possible, and care was exercised in feeding. In another series of tests conducted at the same time with farmer-owned machines that were not especially adjusted to kill the largest number of borers, the mortality ranged from 86 to 96 per cent. The maximum kill was obtained when stalks were cut in lengths of three-quarters to one-half inch.

IMPORTANCE OF SHREDDING IN EASTERN PART OF CORN BELT

The use of shredded stover is common in the eastern part of the Corn Belt. In western Ohio and southeastern Michigan the fodder grown on about 25 per cent of the 1927 corn acreage was shredded. In Indiana and other States to the westward the number of acres of corn shredded, and the percentage of the total acreage shredded, were much smaller than in Ohio.

The practice of shredding corn fodder was formerly more nearly widespread over the Corn Belt than at present. Before the introduction of silos, the corn from a large part of the acreage that is now put in the silo was husked and shredded to provide roughage for cattle. The increase in the acreage of clover, alfalfa, and other legumes has also lessened the need for other roughage. The steady reduction in the number of horses in cities and on farms has been a large factor in reducing the demand for hay, which has lessened the

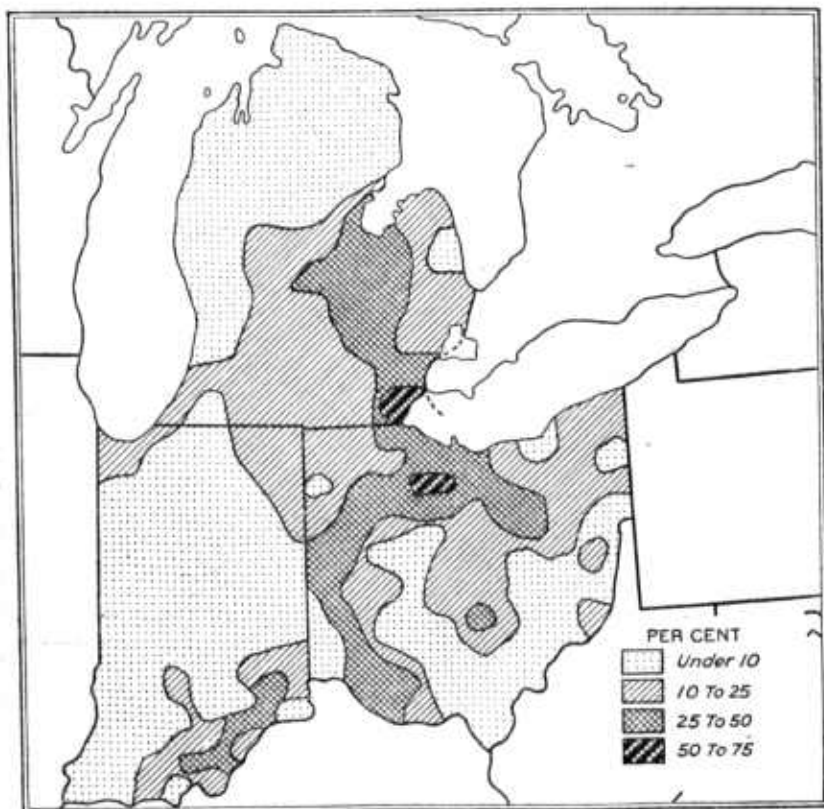


FIG. 2.—Percentage of corn acreage shredded in the eastern part of the Corn Belt, 1927. (Division of Crop and Livestock Estimates)

advantage of shredding on farms where hay was formerly sold and livestock wintered largely on shredded stover.

Shredding is most important in those districts and on those farms where there is a shortage of hay or straw for roughage. Farmers who have too few cattle to make a silo practicable often shred to provide sufficient roughage. Another group that uses the husker-shredder rather regularly consists of those with large herds of dairy cows, which require a large quantity of roughage not only for feed but for bedding. Over a large area in southwestern Ohio, corn is cut to make it possible to sow winter wheat and is shredded principally to get the corn husked.

Some farmers use a large share of the clover in the rotation for pasture, thus making it necessary to supplement the quantity of hay available for wintering livestock by providing corn stover. Some men feed shredded stover instead of silage because they consider a silo too expensive at present prices. A few farmers prefer to feed the shredded stover, even though they have silos, so they can have the corn for hog feeding.

The importance of shredding in the eastern Corn Belt is shown in Figures 2 and 3, which give the acreage of corn per farm shredded

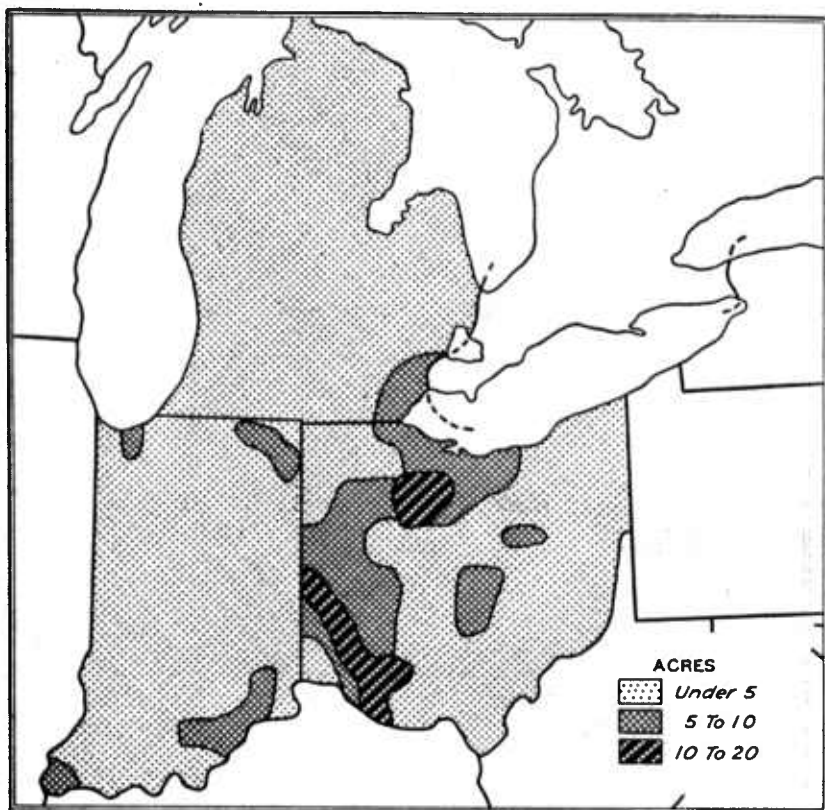


FIG. 3.—Acres per farm of corn shredded in 1927. (Division of Crop and Livestock Estimates)

in 1927 and its percentage of the total corn acreage. North-central and southwestern Ohio, together with parts of eastern and central Michigan, are the districts in which the most shredding was done in that year. Throughout Indiana shredding is relatively unimportant at present.

Figures 4 and 5 represent those districts in which the use of the husker-shredder might be materially increased without cutting and shocking any more corn than is cut at present. They show the acreage of corn per farm that is husked out of the shock by hand or fed without husking. In four or five counties in Indiana and Ohio the acreage of corn fed from the shock without husking is rather high.

As a rule, however, most of the corn acreage designated in Figure 4 is husked out of the shock by hand.

FEEDING SHREDDED STOVER

Feeding experiments indicate that shredded stover has about the same feeding value as unshredded stover that is in equally good condition.² If the shredded stover keeps well it will probably have a greater feeding value than shock fodder that has weathered con-

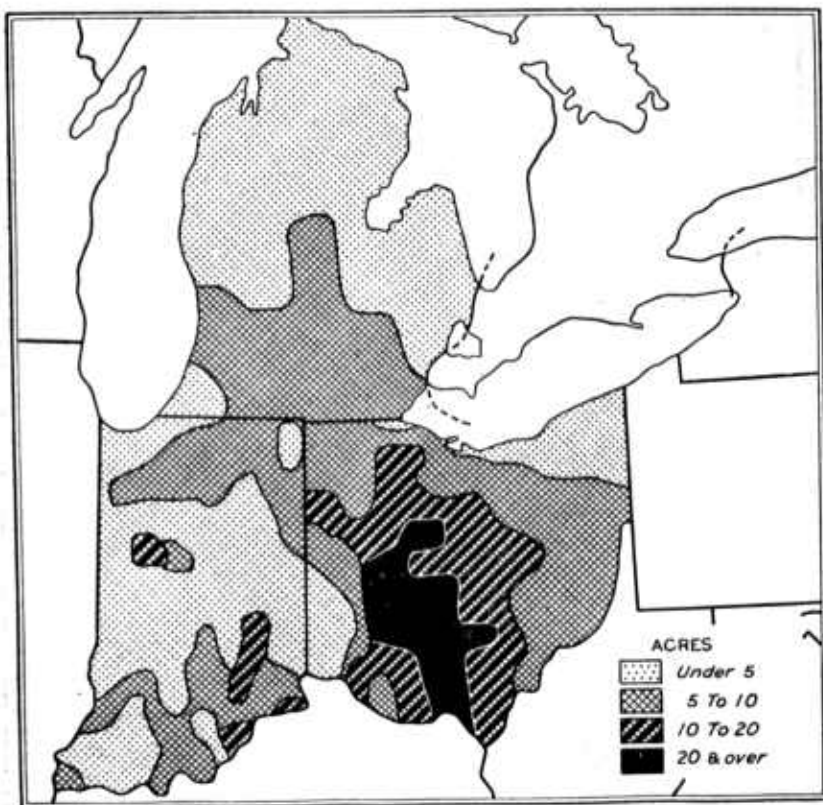


FIG. 4.—Acres of corn per farm husked from the shock by hand or fed without husking, 1927. (Division of Crop and Livestock Estimates)

siderably by being left in the field all winter. If there is considerable spoilage in the shredded stover the long stover may be worth more for feeding purposes if it has been so well shocked that the loss from weathering is not great. The advantages in shredding, therefore, from the viewpoint of the livestock producer, are rather in the ease of handling, in reduction in space for storage, and in having a supply of satisfactory bedding material.

It should be borne in mind that shredded stover is deficient in protein and accordingly is better suited to wintering mature animals

²WATERS, H. J. WINTERING YEARLING CATTLE. Missouri Agr. Expt. Sta. Bul. 75, 53 p. 1907.

such as idle horses, breeding cattle, or dry cows. If fed to young stock it should be used sparingly and with a liberal quantity of protein supplement. The protein may be supplied in the form of a legume hay as alfalfa, clover, or soy-bean hay. If legume roughage is not available, it will be well to feed a protein concentrate in the form of meal or cake, such as linseed, cottonseed, soy-bean, or a gluten feed, depending upon cost and availability.

Many farmers claim that shredded stover is better than oat straw or timothy hay for milk cows and better than straw for horses. The feeding of both straw and stover is no doubt more satisfactory than

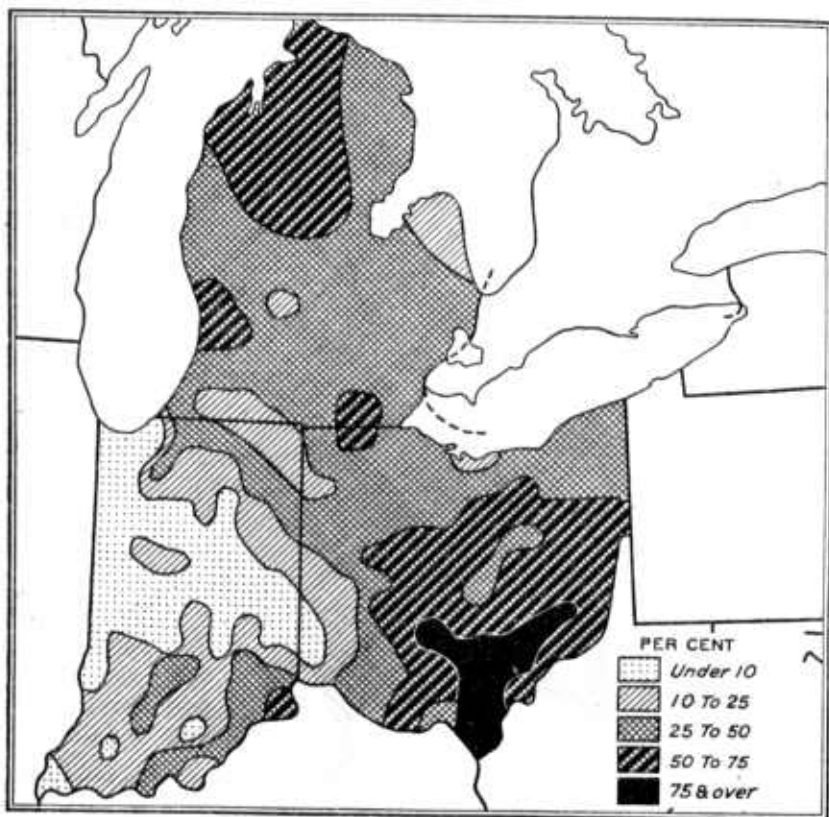


FIG. 5.—Percentage of corn husked from shock by hand or fed without husking, 1927. (Division of Crop and Livestock Estimates)

feeding either one as the sole roughage. A liberal quantity of shredded stover twice a day, with a light feed of timothy or mixed hay once a day, and 3 or 4 pounds of corn or oats, comprises a satisfactory winter ration for the farm work stock. The keeping of salt before them at all times and the addition of about 1 pound of linseed or cottonseed meal per head per day are especially important in a ration for horses in which shredded stover is the only roughage. This precaution will keep the digestive tract in good order and reduce the danger of impaction.

Beef-cow herds that are not milked may be economically wintered on corn stover and oat straw with some legume hay for roughage, but

for milk cows it is important to feed legume hay more liberally and a protein concentrate in connection with it. On farms that have only four to six milk cows, where the use of a silo is impracticable, the feeding of shredded stover reduces the hay requirement and adds variety to the ration.

Shredded stover that has been stored in good condition is a satisfactory roughage for wintering sheep, especially in the first part of the winter. Toward spring and just previous to lambing time it is advisable to increase the proportion of legume hay fed to ewes to provide an adequate milk supply for lambs.

Livestock should not be forced to eat corn stover too closely. It is much better to feed a quantity of stover and other feeds so that they can leave the least valuable portions of the stover.

RATIONS CONTAINING SHREDDED STOVER

The rations with and without silage for different classes of livestock are suggested below as a guide in feeding. The availability and cost of other feeds, as well as the size and individuality of the animals in a group, often make some variation from these rations desirable. It is assumed that only one-half to two-thirds of the quantity of shredded stover fed will be eaten.

MILK COWS

Pounds		Pounds	
Shredded stover_____	10	Shredded stover_____	25
Corn silage_____	30	Legume hay_____	10
Legume hay_____	7	Ground corn and oats_____	7
Ground corn and oats_____	6	Linseed meal_____	2
Linseed or cottonseed meal_____	1.5		

BEEF COWS

Pounds		Pounds	
Shredded stover_____	10	Shredded stover_____	15
Corn silage_____	35	Legume hay_____	10
Linseed or cottonseed meal_____	1	Corn and oats_____	3

YEARLING CATTLE

Pounds		Pounds	
Shredded stover_____	5	Shredded stover_____	7
Corn silage_____	15	Legume hay_____	10
Legume hay_____	5	Linseed or cottonseed meal_____	1

BREEDING EWES

Pounds		Pounds	
Shredded stover_____	2	Linseed meal_____	0.25
Corn silage_____	2	Shredded stover_____	4
Legume hay_____	1	Legume hay_____	2
Shelled corn_____	.5		

HORSES (IBLE) PER 1,000 POUNDS LIVE WEIGHT

Pounds		Pounds	
Shredded stover_____	10	Shredded stover_____	18
Legume hay_____	3	Linseed or cottonseed meal_____	1
Ear corn_____	5		

SHREDDED STOVER AS BEDDING

One of the important reasons for shredding on many farms is to get an added supply of good bedding. Ordinarily from one-third

to one-half of the stover that is fed to livestock is refused. This is taken out of the manger and is used for bedding. Some farmers, who have plenty of straw for bedding, prefer to use shredded stover for certain classes of livestock. It is more convenient to use the refused stover for bedding than to go to the straw stack in bad weather. The shredded stover also is more readily absorbent than straw and does not work back in the stall so freely. Some think that the shredded stover is more absorbent than the cut stover, but both kinds make good bedding. They are equally valuable for cattle, horses, sheep, and hogs.

As compared with unshredded stover, the shredded material makes much better bedding and makes manure that is more easily handled. The greater ease in handling this material when cleaning out the barns and feed lots is generally recognized by those who have used the shredded stover.

MECHANICAL FEATURES OF HUSKER-SHREDDER

The husker-shredder is a stationary machine which snaps and husks the ears of corn and at the same time cuts or shreds the

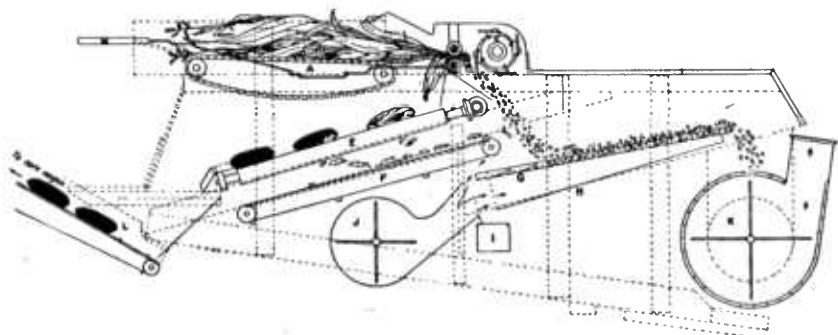


FIG. 6.—The ears are snapped off and husked while the stalks and leaves are cut into lengths or shredded and then blown into the barn loft or other storage space. A, traveling feed table; B, snapping rolls; C, cutter head; D, cutter bar; E, husking rolls; F, husk carrier; G, separator screen; H, cleaning shoe; I, shelled corn pan; K, blower; L, ear-corn carrier; M, safety lever.

stalks and leaves. The husked ears are delivered from the machine to a wagon or crib, and the shredded stover is blown to its place of storage. For a machine performing these duties the mechanical features involved are simple in both design and operation. There is, naturally, some variation as between the different machines, but the story of the various operations as portrayed in Figure 6 essentially characterizes the function of the standard husker-shredder of to-day. Four major operations are required of the machine before the products are ready for disposal: Snapping, husking, shredding, and cleaning.

Three types of heads are in common use on husker-shredders. The cutter head is equipped with knives similar to those on a silage cutter which cuts the stalks into lengths of one-half inch to 4 inches. The shredder head is made up of a large number of whirling blades which tear the stalks and leaves into shreds but do not cut them off

into short pieces as does the cutter head. A machine with a combination cutter and shredder head performs both of these operations. In this case the knives are sometimes set to cut at a greater length than if the cutter head only is used.

As the stalks are fed into the machine the ears are immediately snapped off and dropped to the husking rolls while the stalks and leaves are cut or shredded and pass on to the blower. Usually some corn is shelled out by the husking rolls. If this corn is carried over into storage in large quantities, it becomes a menace to the keeping qualities of the shredded stover. It is the duty of the cleaning device to separate both the shelled corn and all foreign matter from the shredded stover before it enters the blower. The shelled corn itself is taken care of later.

The husking unit is comprised of two cylindrical rolls, one revolving counterwise to the other. These rolls are inclined downward to insure movement of the ears and are several feet long to provide ample opportunity for proper husking. The size of the shredder is indicated rather accurately by the number of husking rolls with which it is equipped. Practically all of the machines in use in 1927 had 4, 6, or 8 rolls. There were a few small machines with only 2 rolls, and a scattering number of 10-roll and 12-roll shredders.

For convenience, the bundles of shocked corn may be pitched from the wagon to the platform on either side of the machine. On large machines the feeding is done from both sides. The husker-shredder is fed either from a gravity or a conveyor table. If the latter is used a safety lever usually is provided for emergencies.

POWER AND FUEL REQUIRED

The amount of power and fuel required for husking and shredding corn fodder depends largely on the size of the husker-shredder. Recommendations of manufacturers indicate that six to eight horsepower per pair of rolls is needed for the most effective operations of husker-shredders. The sizes of gas engines and tractors commonly used to operate shredders of different sizes are about as follows:

	Horsepower
2-roll.....	8-10
4-roll.....	16-18
6-roll.....	18-20
8-roll.....	26-30
10-roll.....	35-40

Stationary engines are commonly used for the small 2-roll machines, and large steam engines are sometimes used for machines with eight rolls or more. Farm tractors are used for operating a majority of shredders, and they are a very satisfactory source of power. A tractor with more power than is needed for a shredder may be used if it is the only one available. A tractor that is not powerful enough to operate the shredder at full capacity may be used with fair satisfaction if the machine is fed slowly.

The quantity of fuel needed will depend upon the size of the engine and the size of the machine it is operating. The average quantity of gasoline or kerosene used per hour by gas engines and tractors

of different sizes when operating shredders, as estimated by the owners in 1927, is as follows:

Rating of engine:

7-12 horsepower	gallons	0.9
16-19 horsepower	do	1.7
20-24 horsepower	do	2.0
25-34 horsepower	do	2.2
35-44 horsepower	do	2.9

The farmers who were using steam engines estimated that they required 158 pounds of coal per hour.

TYPICAL SHREDDING CREWS

Table 1 shows typical shredding crews for machines of different sizes. The amount of labor available, and the distance from the cornfield to the barn, may make it advisable to use more or fewer men in individual cases than in these typical crews. Two men and two teams usually operate the 2-roll shredders by hauling in two loads at a time and then unloading them. With two additional men, one to help load in the field and one to feed the shredder, the wagons and shredder could be kept going more steadily. The 10-roll and 12-roll machines require at least 7 teams and 14 men under normal conditions to keep them running at capacity.

TABLE 1.—*Typical shredding crews for shredders of different sizes*

Operation	Size of shredder					
	4-roll		6-roll		8-roll	
	Men	Horses	Men	Horses	Men	Horses
Hauling fodder	3	6	4	8	5	10
Loading fodder	2		2		3	
Feeding shredder	1		1		1	
Cribbing corn	1	2	1	2	2	2
Operating tractor			1		1	
Total	7	8	9	10	12	12

The man operating the tractor in connection with the larger machines alternates with the man feeding the shredder. He may also help by pulling remnant husks off the ear corn, tending to the shelled corn, and adjusting the hood of the blower to spread the stover more evenly in the barn. It is not considered so necessary to have two men to feed the 4-roll shredder as in the case of the larger sizes, yet it is usual for other men on the job to alternate with the regular man in feeding even a 4-roll shredder. Feeding the fodder into the shredder is always a strenuous task even if the bands are cut by the man who is unloading. The bundles should be spread apart and fed into the machine regularly, with some stalks lapping continuously, so the load on the tractor may be uniform and so the greatest quantity of fodder may be shredded in a given time. A part of the shredding crew for a 6-roll machine is shown in Figure 7.

The amount of labor necessary per acre varies according to the yield of corn. According to figures obtained from farmers who shredded in 1927, the total labor, including the time of the machine crew, required per acre for different yields of corn, is about as follows:

Bushels per acre:	Man-hours
20.....	7.6
30.....	9.1
40.....	10.7
50.....	12.2
60.....	13.8
70.....	15.3

RATE OF HUSKING

The rate of husking as expressed in bushels per hour depends on the size of shredder, number of men in the crew, and yield of corn per acre. Table 2 shows what may be accomplished with a full crew



FIG. 7.—In addition to advantages of feeding and bedding this method of handling corn requires less man labor than if it is husked out of the shock by hand

by machines of different sizes in specified yields of corn. In corn yielding 35 bushels per acre the rate of husking varies from about 16 bushels per hour for a 2-roll shredder to 48 bushels per hour for the 10-roll size.

SAVING THE SHELLED CORN

Some of the corn is shelled from the ears as it goes through the machine. The extent of shelling depends on the maturity of the corn, size of the ears, adjustment of the snapping and husking rolls, and care used in feeding the shredder. If a large share of the corn is not matured before cutting, or if many of the ears are small, the corn is more likely to shell out. Information obtained from farmers who shredded in 1927 indicates that 9 per cent of the corn husked on those farms was shelled in shredding.

If the shelled corn is kept in large quantities or if it is piled high there is danger of spoilage unless it is fed soon after shredding. Many farmers mix it with whole oats or barley to absorb some of the moisture and reduce the danger of heating and molding. Others spread it out in a thin layer over the granary or barn floor. To put the shelled corn in sacks that are stood upright so that they do not touch each other, in a well-ventilated driveway, is a convenient and satisfactory method of handling. Usually there is not more than can be fed before it is seriously damaged.

TABLE 2.—*Bushels per hour husked by machines of different sizes with specified yields of corn*

Size of shredder	Yield of corn per acre		
	20 bushels	35 bushels	50 bushels
	<i>Bushels per hour</i>	<i>Bushels per hour</i>	<i>Bushels per hour</i>
2-roll.....	12	16	20
4-roll.....	18	24	30
6-roll.....	24	32	40
8-roll.....	30	40	50
10-roll.....	36	48	60

The percentage of shelled corn may be controlled somewhat by careful feeding of the shredder. Putting large bundles of fodder in the machine without spreading them out sufficiently is one of the principal causes of shelling. Feeding a small machine beyond its capacity, especially if it is fed in rather irregular bunches, usually fills the shelled-corn sack quickly.

STORING THE STOVER

Shredded stover is usually stored, for winter feeding, in the barn or feeding shed within easy access of the stock to which it is fed. The storage requirements for stover are similar to those for hay. Where large quantities are fed, a separate mow usually is set aside for storage purposes or smaller quantities are stored on top of the hay, over the drive floor of the barn, or in similar available places. Because of the advantage of having the roughage under cover and convenient for barn feeding, shredded stover seldom is stored outside but sometimes a self-feeding rack of considerable capacity is used for yard feeding, to be refilled as needed. (Fig. 8.) This practice is limited largely to farms on which the shredder is owned, because of the expense of shredding comparatively small quantities at different times. If there is not enough storage space for the stover that is required, shredding may be done again later in the season as mow space becomes available. When market hay is not sold until after shredding time, a lack of mow space sometimes necessitates a second shredding.

The method of storing the stover varies on different farms. Some farmers, especially if there is a shortage of mow space, pack the stover by tramping it at intervals. If in very good condition, stover keeps equally well whether it is packed or not, but if it is at all damp the stover should not be tramped. Another practice is to blow the stover upward against a baffle board nailed to the rafters

of the barn. Such a scheme tends to spread it uniformly as it drops to the mow.

Proper manipulation of the hood of the blower frequently saves much hand labor in the mow and possible spoilage of the stover. If conditions permit, the hood is adjusted so that the stover is blown into the far corners and sides of the mow, which are usually filled first.

Shredded stover, in good condition, may be safely stored to any depth within the confines of the barn. On some farms stover is stored as deep as 30 feet. On other farms, because of the small quantity shredded, or the poor condition of the stover, it is sometimes piled as low as 2 feet. Where the moisture is high, stover is usually stored at a minimum depth depending on other available mow space.



FIG. 8.—Shredded stover that has been blown into a large open rack is convenient to feed, although it is more difficult to dispose of the refused portions. It will be necessary to shred several times during the winter if this practice is followed.

SPACE REQUIREMENTS

The quantity of shredded stover that may be stored in a given space depends on the method and depth of storing and the condition of the corn at time of shredding. A high mow of stover that is packed as stored and that contains a maximum percentage of moisture consistent with safe keeping will obviously require a minimum of space per unit, in comparison with the requirements of storage under other conditions.

Table 3 shows the space requirement per ton for shredded stover on 70 farms, in 1927. The number of cubic feet per ton was determined by dividing the total space occupied by the stover by the farmers' estimate of the number of tons shredded. The average number of cubic feet required for a ton of shredded stover on the farms indicated is 610. This number falls within the space range in

the table of the largest number of farms reporting and should be rather typical.

TABLE 3.—*Estimated volume per ton of shredded stover*

Cubic feet per ton	Number of estimates
300 or less.....	5
301 to 500.....	16
501 to 700.....	30
701 to 900.....	14
901 or over.....	5

PREVENTING SPOILAGE

Shredded stover, when stored in piles, goes through a heating stage similar to that of kindred crops. The result of excessive heating is manifested by a mold on the stover varying in color from white to dark brown, the latter carrying a musty odor. Badly spoiled stover may endanger the lives of stock to which it is fed and may be unfit even for bedding.

Excessive moisture is the chief cause of spoilage of stover in storage. Rain or snow on the corn at the time of shredding, or the excessive moisture in immature corn may cause spoiled stover. If both internal and external moisture are present in appreciable amounts, spoilage is likely to occur unless precaution is taken to safeguard the crop. If wet stover is stored in high piles, it is frequently necessary to remove a large share of the stover from the top of the pile to prevent serious loss. Some farmers dig trenches through the pile at intervals in such cases.

Undoubtedly some corn is shredded each season which is not in proper condition for storage. This is especially true if the shredding is done with a hired machine which is in demand for a number of jobs. In this case the corn frequently is not in the best condition to shred when the machine is available.

Spoilage is most likely to occur if the blower is left too long in one position. If the blower is not rotated, or the adjustment of the hood is not frequently changed, all of the heavy material drops in one place while the lighter material is blown some distance away. The accumulation directly under the hood thus consists of the heavy wet butts of the stalks and the shelled corn blown over with the stover, both of which are important causes of heating. The judgment of most farmers indicates that the hood of the blower should be adjusted frequently so that the stover will be packed as little as possible in getting it spread over the mow. The stover should be tramped as little as possible in leveling any accumulated piles, and for some time after it has started to heat no one should be allowed in the mow.

WHEN TO SHRED

The shredding season may extend from the last of October to the middle of March, but the months of November and December represent the best time to shred. More than half of the shredding usually is done between November 15 and December 15. Many farmers who use husker-shredders feel that from four to six weeks after cutting and shocking is a good time to shred. At this time the fodder is

well cured but has not suffered greatly from weathering in the field, the drizzly fall rains are usually over, and colder weather is coming on, so that the stover is more likely to keep without spoiling. Moreover, this allows some time for other fall work such as bean threshing, the harvesting of standing corn, and fall plowing, before shredding time.

Corn for shredding purposes should be cut at about the same time as it should be cut for husking out of the shock. The corn should be well matured, with the kernels fully dented and the husks entirely yellow. Probably most of the lower leaves will be dry at this stage of maturity.

If the stover is to be piled to any considerable depth, shredding should not be done soon after a rain unless the fodder has thoroughly dried. Shredding while there is snow, sleet, or ice on the shocks also is likely to induce spoilage. Bright, cool weather at a time when the fodder is well cured and dry is always a good time to shred.

Shredding may be done later in the winter if there is not enough mow space to allow all of it to be done at one time, or if it is thought that the stover will keep better if shredded at intervals. Well-shocked corn fodder often appears to be in as good shape in January or February as in November. Aside from the weathering of the stalks on the outside of the shocks and the greater loss occurring in twisted and down shocks the principal disadvantage in late shredding is the difficulty of finding good weather for it. Then there is likely to be snow on the shocks, and the butts often are frozen down, especially if the corn was cut when the ground was wet. Butts frozen with mud and ice constitute an important cause of stover spoilage.

USE OF HUSKER-SHREDDER COMPARED WITH OTHER METHODS OF HUSKING CORN AND UTILIZING OR DISPOSING OF STALKS

A common method of harvesting shocked corn consists of husking out the corn by hand, reshocking the bundles by putting from three to five corn shocks into a "fodder" shock, hauling in and cribbing the ear corn, and finally hauling in the stover. The labor required by this method of harvesting corn that yields 40 bushels per acre is about as shown in Table 4.

TABLE 4.—*Labor requirements for handling shocked corn*

	Man-hours	Horse-hours
	<i>Per acre</i>	<i>Per acre</i>
Husking from shock ¹	11	0
Hauling and cribbing corn ²	2	4
Hauling stover to barn ³	6	6
Total.....	19	10

¹ Based on replies from farmers interviewed in 1927, and on the following publications: FALCONER, J. I., and DOWLER, J. F. VARIATIONS IN COSTS OF PRODUCING CORN, WHEAT, AND OTHER CROPS IN GREENE COUNTY, OHIO. Ohio Agr. Expt. Sta. Bul. 393, p. 233-284, illus. 1926.

HUTSON, J. B., and FINN, W. G. MAN LABOR, HORSE WORK, AND MATERIALS USED IN PRODUCING CROPS IN CHRISTIAN COUNTY. Ky. Agr. Expt. Sta. Bul. 274, p. [383]-434, illus. 1926.

JOHNSON, O. M., and DADISMAN, A. J. AMOUNT AND COST OF LABOR REQUIRED FOR CROWING CROPS IN WEST VIRGINIA. W. Va. Agr. Expt. Sta. Bul. 163, 11 p., illus. 1916.

MOWRY, H. H. THE NORMAL DAY'S WORK OF FARM IMPLEMENTS, WORKMEN, AND CREWS IN WESTERN NEW YORK. U. S. Dept. Agr. Bul. 412, 16 p. 1916.

² See FALCONER, J. I., and DOWLER, J. F. Op. cit. Table 15.

³ Based on FALCONER, J. I., and DOWLER, J. F. Op. cit. p. 253.

Aside from the machine crew, about 8 man-hours and 10 horse-hours per acre are necessary for husking and shredding corn with the same yield per acre. This means a saving of 11 hours of man labor per acre. At 30 cents per hour, this saving in man labor would be worth more than 8 cents per bushel of corn husked, which would be sufficient to meet the cost of hiring or owning a husker-shredder.

In some instances where the labor for husking out of the shock was hired, the rate per bushel paid was higher than that charged for the use of husker-shredders. In addition there are other advantages of shredding which can hardly be measured in dollars and cents. One common statement of the advantage of using a husker-shredder over hand husking was that "when night comes the corn is in the crib and the fodder is in the barn."

If the corn is husked out of the shock by hand, the stover is usually hauled to the barn as it is needed for livestock. The unshredded stover requires at least twice as much room in the barn as it would if

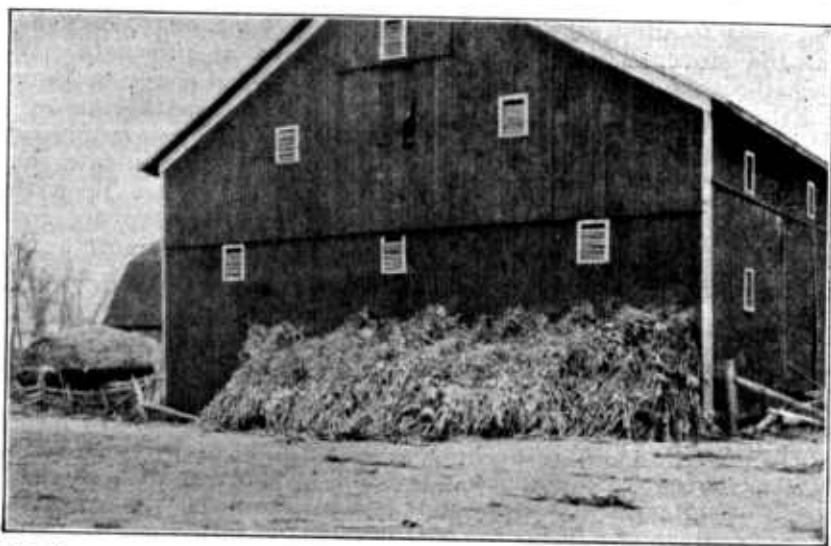


FIG. 9.—The long stover that has been husked out by hand is generally piled out of doors, although there may be room in the barn loft

it were shredded. Most barns are not built to store unshredded stover conveniently, but the husker-shredder can blow shredded stover into a hay loft or other space that would not otherwise be accessible. Even when there is room in the barn loft, unshredded stover is often piled outside or stood against the barn, as in Figure 9.

Shredded stover is easier to handle and to feed than stover that is not shredded. Bundles of unshredded stover are often pulled out of the rack and trampled into the manure. The shredded stover is more absorbent as bedding than unshredded stover and is more easily handled in hauling out the manure than are the long stalks. Often the unshredded stalks must be left a year to rot to avoid considerable trouble in hauling them to the field.

Since the unshredded stover ordinarily can not be put in the barn on account of lack of space it often is left in the field for the greater part of the winter, and there is considerable loss by weathering.

This loss is greatest if the corn has not been well shocked. Figure 10 shows that shocks which have been left out all winter often are badly twisted or fallen.

With increased corn-borer infestation in prospect the use of the husker-shredder has another advantage in the disposal of stalks. It is difficult to burn the long stalks that have been partly trampled into the manure, and it often is not feasible to bury them deeply enough to prevent the emergence of the corn borer in the spring. If the unshredded stover is fed to livestock on pastures the remaining stalks should be raked and burned, or plowed under. This extra work would be obviated by shredding.

On farms where the livestock do not require the corn stover for roughage, the single advantage of shredding in the disposal of corn-stalks in corn-borer control is not sufficient to overbalance the excess labor of cutting, shocking, and shredding over that of husking from the standing stalks. Husking from the standing stalks requires



FIG. 10.—The loss from weathering of shock corn that is left in the field all winter is much greater if the shocks are down or twisted

about 8 hours per acre in corn yielding 40 bushels per acre, whereas cutting, shocking, and shredding require at least 13 hours of man labor per acre in addition to the machine cost of shredding.

If corn fodder is fed without husking there is no advantage in shredding unless corn-borer control is considered. In this case no labor is saved by husking, and there is but little difference in the feeding value of the roughage whether shredded or unshredded. Many farmers, however, would prefer to grind their corn if it were husked. When increased corn-borer infestation makes control measures imperative, they no doubt will use the husker-shredder more generally because of its important advantage of destroying the borers in the stalks.

Where corn is now husked from the shock by hand the use of the husker-shredder is entirely justified, aside from any advantages in disposal of stalks, unless a farmer is willing to expend his own labor at much less than the usual rate for hired labor to avoid the cash outlay for the use of a machine. Where corn is now fed from the

shock without husking, the disposal of the stalks in the destruction of corn borers will make the use of husker-shredders practicable. Where corn fodder is not necessary as roughage or bedding for live-stock, the disposal of cornstalks will be accomplished more easily by leaving them in the field than by cutting, shocking, shredding, and scattering them over the field again.

FIRST COST, DEPRECIATION, AND REPAIRS

The annual depreciation charge depends on the first cost of the machine and the number of years of usefulness. The total life of the shredder depends upon the care with which the machine is operated and the number of hours of use per year. The average estimated life of husker-shredders operated by 47 farmers in 1927 was 15 years.

Table 5 shows the approximate first cost of shredders of different sizes at present prices and the annual depreciation based on 15 years of use. The type of head, whether shredder, knife, or combination types, and the kind of construction, account for a considerable portion of the variation which exists in the price of different makes of the same size.

TABLE 5.—*Purchase price, annual depreciation, and repairs of husker-shredders of different sizes*

Size of shredder	First cost	Annual depreciation	Annual repairs
2-roll.....	\$350	\$23.30	\$5.60
4-roll.....	500	33.30	8.00
6-roll.....	650	43.30	10.50
8-roll.....	850	56.70	13.60
10-roll.....	1,100	73.30	17.60

In a study of the operation of husker-shredders in 1927, it was found that repair costs amounted to about 1.6 per cent of the first cost. This item of expense for the different-sized shredders is also given in Table 5.

SHALL I BUY A HUSKER-SHREDDER?

Whether to buy or to hire a shredder depends largely on the availability of machines doing custom work. Farmers who hired machines in 1927 paid about \$2.50 per hour for 4-roll shredders, \$3 per hour for the 6-roll size, \$3.75 for the 8-roll, and \$4 an hour for the use of the 10-roll shredders. These rates are based on the assumption that the owner of the machine furnished the power, the fuel, and one or two men to feed the shredder. There was a variation of 25 to 50 cents an hour depending on whether the fuel was furnished.

On a per-bushel basis, the rate charged varies with the yield per acre of corn. With a yield of 25 bushels an acre a charge of 10 cents per bushel for shredding is common. Where corn yields 45 bushels, 7 cents per bushel is usual, and for a 60-bushel yield, shredding is often done for 6 cents a bushel.

If a machine can be hired at these rates at the approximate time it is desired to shred, there is less incentive to buy one than if the nearest machine is a long distance away and has a large number of other jobs. When it is difficult to get a shredder at the right time and when the corn acreage to be shredded by a farmer and his neighbors will justify the purchase of a shredder, it is well to think about buying one. A farmer who is mechanically inclined may buy it himself and do custom work for his neighbors, or the group may reduce the original outlay for each by buying and operating it co-operatively. If operated cooperatively the owners should be men who expect to live on their farms for several years.

KIND OF SHREDDER TO BUY

The size of shredder to buy depends on the acreage of corn it is expected to shred each year and the normal yield of corn per acre, as well as the power available for operating it. One fairly satisfactory rule is that 80 to 100 hours of use per season will justify the purchase of a shredder. Less than 80 hours per season may be sufficient if shredding at a particular time seems more important than a low cost per hour of use. In corn that yields 35 bushels per acre, 100 hours of shredding would mean about 45 acres for a 2-roll machine, 70 acres for the 4-roll size, 90 acres for the 6-roll, 110 acres for the 8-roll, and 135 acres for the 10-roll shredder.

In many communities there has been a tendency toward the use of smaller-sized husker-shredders than were formerly used. The lesser amount of shredding done, incident to the coming of the silo, partly explains the decreased use of large shredders, which, to pay for themselves, must do considerable custom work.

The use of an 8-roll, 10-roll, or 12-roll shredder requires a large crew which is sometimes difficult to get together. Use of large crews is often wasteful of labor during forced delays caused by breakage or other causes. The principal disadvantage of the large machine, however, especially on farms on which only a small corn acreage is shredded, is that some farmers are forced to shred at inopportune times. Many farmers feed the long fodder instead of shredding it or have more spoilage than they should have, because they are in a large ring of customers and can not shred at the right time.

The cooperative ownership of the 4-roll and 6-roll sizes has become popular in some localities. If distributed among six or eight farmers there would be an original outlay of about \$80 each. If 15 acres of corn, yielding 30 bushels per acre, were shredded by each owner each year for 10 years the depreciation cost would be less than 2 cents per bushel husked.

With a share in the ownership of the machine, the individual has more opportunity to choose the time to shred, and he has more chance to shred at intervals, if his mow space seems to make that desirable, than if he were dependent on hiring a custom machine.

The place for large-sized shredders is on farms where large acreages of corn are shredded. For instance, six farmers, each with 25 acres of corn to shred, might well use an 8-roll machine. This acreage would keep a machine of this size busy for about 18 days, which would insure economical operation and still allow each farmer to

shred at approximately the time he wished, whether all at one time or at intervals. The large farms also are more likely to have extra hired help to operate the large shredder.

The type of head is a consideration in which farmers who are contemplating the purchase of a husker-shredder are interested. Most of the men who have had experience with shredders prefer the shredder-head to the cutter-head type. The farmers who use a shredder head claim that they entail less bother and expense since there are no knives to sharpen, and that as the shredded stover does not pack so tightly in the mow, it keeps better. It sometimes is necessary to handle the cut stover with a scoop or basket, whereas the shredded material may be pitched with a barley fork or carried in the arms.

For bedding, the shredded stover is somewhat more absorbent and does not work back in the stall so freely as the cut stover. The shredder head may require somewhat more power unless the knives on the cutter-type head became dull. Stover that has been cut into very short lengths sometimes cause sore mouths in livestock.

The cutter-type head has an advantage in that it may be used in cutting green fodder for silage or in husking out dry fodder to be cut up for stover silage with the addition of a large quantity of water. The cut stover also requires less space in the mow than does the shredded. By adding two extra knives on some machines, the stalks may be cut to a length of 2 inches instead of 4. Adjusting the speed of the apron is another means of changing the length at which stalks are cut. The combination shredder and knife head has most of the advantages of both types, although it usually costs somewhat more.

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